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Mr. Steele is active in the departmental and committee work of the Highway Research Board, a constituent agency of the National Academy of Sciences. He is author or co-author of numerous technical reports, papers, and articles in his areas of responsibility. He was graduated from Purdue University in 1929 with the degree of bachelor of science in civil engineering, and from the University of Wisconsin in 1933 with the degree of master of philosophy in economics.

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Future Economic Problems of Large Cities

HORACE W. HARDING
Research Department Manager
Chamber of Commerce of Kansas City

A century ago the United States was essentially a rural society largely living on farms, or in small villages whose economic reason for existence was to serve the area's farms. Travel was slow and a trip, to what would now be the nearby county seat, might take a day or more.

The relatively few cities of significant size were compact centers of industrial and commercial activity. People lived in houses built close together or in tenements within walking distance of factories or businesses where they worked. At least, they lived near a trolley that ran out only a short distance from the center of the city. Boundaries distinctly marked the limits of concentrated habitations and the rural country side.

In these cities there was no need for expressways or for parking facilities. Sanitation problems were handled by a central public sewer system without the need for huge complicated disposal facilities. The people were more self-sufficient and neither expected nor received the governmental services deemed essential today. Police and fire protection were easily provided, though perhaps not always of best quality. Water requirements were far less and there was little need for elaborate systems of dams, reservoirs and aqueducts. Educational needs were more easily met. Not many young people progressed beyond the eighth grade.

But most important, a form of local government had been devised to handle the needs of city dwellers and the rural population outside city boundaries. Local governmental structure allowed for a realistic, economic, and relatively efficient allocation of resources to the private and public sectors of the economy. No overlapping of functions existed and only one agency of government was responsible for serving all people in the city. Even less government was required by the rural inhabitants.

PRESENT BIG CITIES

Today, ". . . the big city areas in the United States are a welter of fragmented, divided communities, each battling the other for the slight advantage one community might possess as compared to the other; and each unable to work together for the common good because of divisions based on class or social status, economic or geographical advantages, or area rivalry fostered by the local press and local business associations."[1]

[1] Remarks by Honorable Frank P. Zeidler, Mayor of Milwaukee, before the U. S. Conference of Mayors, 1959 annual conference, Los

Large cities today are essentially economic entities without status in the legal sense. "They are composed of groups of political entities which, though inter-dependent on one another, at least economically, go about their business in separate and frequently different ways, generally uncoordinated and sometimes even contradictory in their handling of common problems. These units of government seldom plan together for future growth but rather are noteworthy for the continuing hassles they engage in about all manner of local governmental business."[2]

How has all this come about and what does it mean? What does all this have to do with *future economic problems of large cities?*

The country's population has been increasing rapidly during the last century, but growth has also brought a shift of people on an even greater scale from rural to urban areas. Back in 1850, only 15 per cent[3] of the people lived in urban places, but today more than 60 per cent reside in Standard Metropolitan Areas. While the nation was growing 134 per cent from 1900 to 1960, population in standard metropolitan areas increased 363 per cent, almost three times as fast. (see chart)

FACTORS IN URBANIZATION

This urbanization has been the result of several factors, not the least of which has been communication and transportation. Senator Williams of New Jersey pointed out at a congressional hearing that "From the earliest time, first the village and then the city, and then the giant metropolitan areas were basically an outgrowth of ease of communication. Geographical proximity made the exchange of services easy. It provided readily available work forces. Ease of transportation has always been one of the most fundamental causes for metropolitan growth."[4]

One should also remember other basic causes, though. This cumulative growth of urbanization came with the ever increasing productivity on farms. New machinery and new agricultural methods not only produced a surplus to feed the city population but released labor to work in city mills and shops, thereby adding even more to city growth. In 1870, slightly more than half of all gainfully employed workers engaged in farming; by 1950 the proportion had dropped to one in eight workers.

"Meanwhile, as markets grew, mass production methods in manufacturing became more feasible. The resulting increases in output per worker were reflected in rising income for the community. This in turn made effective new consumer wants. To fill these demands a host of service industries emerged in the fields of recreation, education, personal and medical care. Commerce and industry also required more and different skills and services."[5]

These were some of the more important causes of city growth, but another development running concurrently has complicated the situation. That area around the old city's boundaries is now occupied with residential areas, shopping centers and even factories.

Angeles, California, **Hearing before the Subcommittee on Reorganization and International Organizations of the Committee on Government Operations, U. S. Senate, Eighty-sixth Congress, First Session on S. 1431 and S. 2397,** p. 45.

[2] Statement of Honorable Gordon S. Clinton, Mayor of Seattle, Washington, on behalf of the American Municipal Association, **Establishing a Commission on Metropolitan Problems and Urban Development, House of Representatives, Eighty-sixth Congress, First Session, Report No. 940,** p. 13.

[3] **Guiding Metropolitan Growth,** Research and Policy Committee, Committee for Economic Development, p. 14.

[4] Testimony of Senator Harrison H. Williams, Jr., **Hearing before the Subcommittee on Reorganization and International Organizations of the Committee on Government Operations, United States Senate, Eighty-sixth Congress, First Session on S. 1431 and S. 2397,** p. 32.

[5] **Guiding Metropolitan Growth,** Research and Policy Committee, Committee for Economic Development, p. 16.

SUBURBAN GROWTH ACCELERATES

Population outside central cities, but in urbanized areas of large cities, has been growing at an even greater rate than have metropolitan areas themselves. The last census revealed that many core cities had even declined in population during the past ten years while their metropolitan areas showed a sizeable increase. Overall, during the last decade, central cities of the Standard Metropolitan Areas had a population increase of only 9.4 per cent, but the area around these cities had an increase of 47.7 per cent. Core cities whose population declined between 1950 and 1960 include Baltimore, Boston, Chicago, Cincinnati, Cleveland, Detroit, Minneapolis, New York, Philadelphia, Pittsburgh, Portland, St. Louis, and San Francisco; yet the metropolitan areas of these cities showed increased population. Many of the central cities which showed increases were able to do so only by annexations of territory.

The trend of urbanization in the United States is not about to stop; in fact, it may accelerate in the future. "An immediate projection by the Bureau of the Census is for a population of 220 million in 1975, an increase of roughly 40 million over 1960. If metropolitan areas continue to get three fourths of this national growth, our metropolitan population in 1975 will approximate 140 million persons. Central cities will still hold great concentrations of people—in the aggregate perhaps 60 million. But the balance will have shifted to areas outside present central city boundaries; 80 million people will live in the suburbs and fringes of metropolitan districts."[6]

Especially during the last fifty years there has been steady migration of young unskilled and semi-skilled workers from the rural south and even from Puerto Rico to metropolitan centers of the northeast, north central and western regions. These people with their families, inexperienced in urban living, have settled mostly in the core of metropolitan centers. While they have helped metropolitan economies

POPULATION GROWTH IN THE UNITED STATES AND ITS CITIES

	United States	Standard Metropolitan Areas					
				Within Central Cities		Outside Central Cities	
	Total (Thous.)	Combined Totals (Thous.)	Per Cent of U.S.	(Thous.)	Per Cent of SMA	(Thous.)	Per Cent of SMA
1900	75,995	24,105	31.8	14,921	61.9	9,184	38.1
1910	91,972	34,517	37.5	22,125	64.1	12,392	35.9
1920	105,711	46,059	43.6	30,077	65.3	15,982	34.7
1930	122,775	61,005	49.7	38,799	63.6	22,206	36.4
1940	131,669	67,127	51.0	41,484	61.8	25,643	38.2
1950	151,326	89,084	58.9	52,244	58.6	36,840	41.4
1960[a]	177,874	111,590	62.7	57,174	51.2	54,417	48.8

[a] Preliminary.

Source: **Guiding Metropolitan Growth,** Research and Policy Committee, Committee for Economic Development, pp. 46-47; U. S. Department of Commerce, Bureau of the Census, **1960 Census of Population,** Preliminary Reports, Population Summaries, PC (P3)-4, p. 8. 209 SMA's in 1960.

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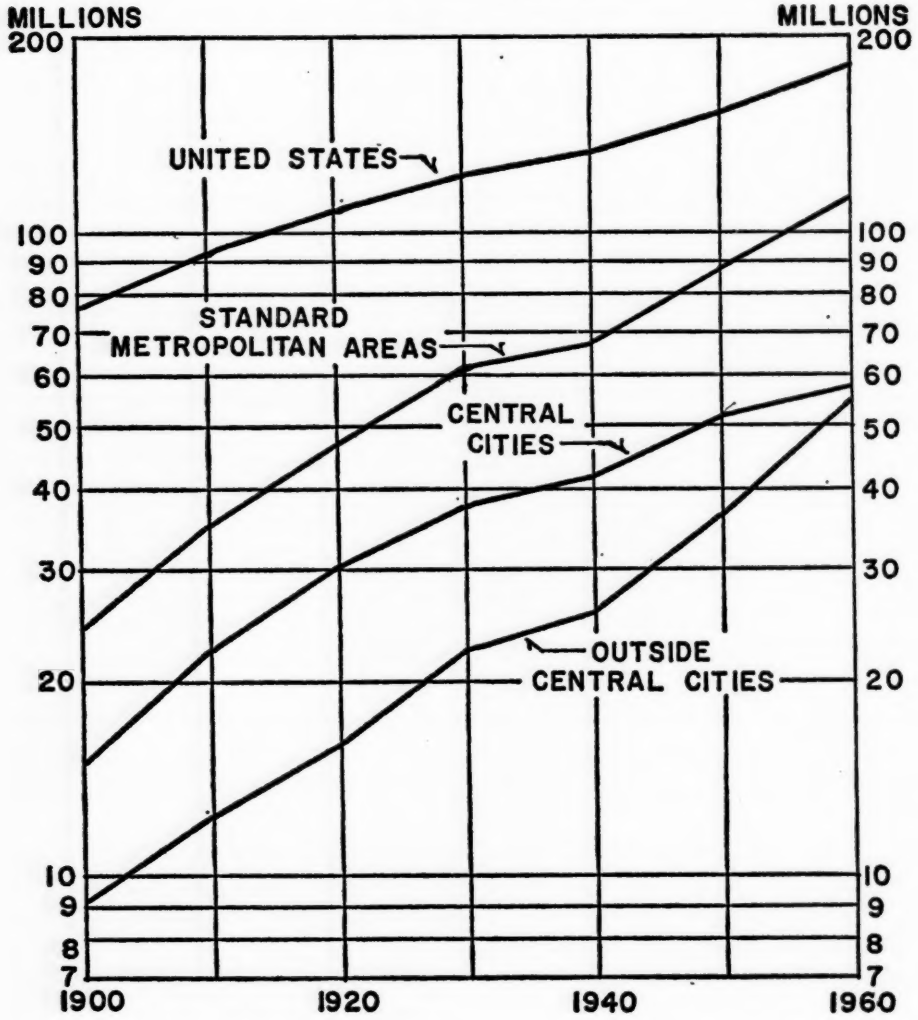
[6] **Guiding Metropolitan Growth,** Research and Policy Committee, Committee for Economic Development, pp. 14-15.

to expand, they have also added to the social costs in these areas.

While these persons were moving into older sections of cities, there has been a simultaneous migration of city dwellers to the suburbs. This movement has also created huge problems for metropolitan areas since most of the migrants are young, middle-income families with children, seeking elbow-room, better schools, and pleasant living conditions in single family houses. As a result, new developments have sprawled all over the countryside, leaving little open space, crowded schools, and spiralling taxes.

POPULATION GROWTH IN THE UNITED STATES AND ITS CITIES, 1900-1960



LOSSES IN CORE CITIES

The older portions of metropolitan cities are losing population. The average size of family in these sections is declining, and the age of city dwellers, relative to the rest of the country, is increasing.

"The city has lost many of the unique features it once enjoyed for manufacturing when compared with suburban locations. It has lost out not only in its unique ability to provide an efficient transportation grid and a large labor force, but also in the provision of rentable industrial space, repair facilities, power, water and sewage. The economies which used to be available for the manufacturer—particularly the small manufacturer—solely in the central city are now to be had in an increasing number of suburban areas."[7]

Economic activity of cities is moving to the fringe areas. This movement is not confined to home building and manufacturing but includes retailing, services and warehousing. Businessmen are also looking for newer structures and more spacious sites.

"Of total production workers in 48 Standard Metropolitan Areas, 66.5 per cent worked in central cities of the areas in 1929; in 1954 the ratio was down to 53.6 per cent. In the post-war years between 1947 and 1954 central cities like Cleveland, Chicago, St. Louis and San Francisco have experienced absolute drops in manufacturing employment of three to eight per cent."[8] In the 12 largest central cities, excluding Los Angeles, there was a loss of around 165,000 manufacturing jobs.

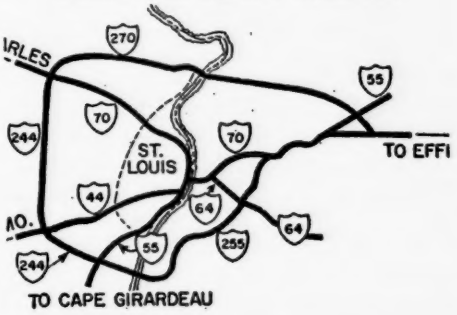
Similar comparisons for retail trade show that between 1929 and 1954, the position of retail trade employment in central cities of metropolitan areas dropped from 78 per cent to 63 per cent and dollar volume sales in downtown areas of Chicago, St. Louis, Philadelphia, Pittsburgh, Detroit and a number of other large cities actually fell off.[9]

Of 13,000,000 homes built in non-farm areas between 1946 and 1958, 85 per cent are outside central cities.

SUBURBAN PROBLEMS

The central cities are not alone in their problems for the suburbs have problems too. Not the least of these is urban sprawl where inadequate planning and zoning have allowed business, industry and residences to be mixed up without regard to economic land use. This, for all intents and purposes, commits the land resources of an area for at least fifty years.

INTERSTATE ROUTES IN METROPOLITAN ST. LOUIS
Missouri State Highway Department



Developers and, in many cases, inhabitants of the newly built-up fringe areas attempted to solve their immediate governmental problems without regard to any overall picture of today's living city. Small municipalities have nearly surrounded the old cities and in cases such as St. Louis have succeeded.

The result has been *fractionated local government*, straining the social fabric and overloading time honored political institu-

[7] Raymond Vernon, "What Is the Business of Cities," **The Little Economics**, Committee for Economic Development, p. 15.

[8] **Guiding Metropolitan Growth**, Research and Policy Committee, Committee for Economic Development, p. 17.

[9] Raymond Vernon, "What is the Business of Cities," **The Little Economies**, Committee for Economic Development, p. 15.

tions. There are more than 16,000 local jurisdictions in fewer than 200 metropolitan areas.[10] Baltimore has 10; Boston, 112; Buffalo, 155; Chicago, 945; Cleveland, 134; Detroit, 250; Los Angeles, 391; Minneapolis, 222; New York, 1,074; Philadelphia, 705; Pittsburgh, 612; St. Louis, 400; San Francisco, 401; and Washington, 67.[11] The Kansas City Metropolitan area (like St. Louis in two states) has four counties and 69 municipalities not to mention the innumerable school districts and special districts to handle water, sewers, etc.

To confuse and complicate the situation even more, creation of new governmental jurisdictions proceeds at a rapid pace. For instance, "St. Louis had eight incorporated municipalities in 1911, 39 in 1940, and 94 in 1952. Between 1952 and 1957, 170 new municipalities were established in metropolitan areas and 519 new non-school special districts were created."[12] The Kansas City area added at least one new municipality during the past year.

Local government in our metropolitan areas looks like the Buddhist idol Kuan Yin, with a thousand arms. Unfortunately, for a sound economy and proper allocation of resources for an entire metropolitan area, the arms do not connect with either a single backbone or a single brain.

Expenditures by these many local governments directly bear on the economy of our large cities. Local government expenditures increased from $700 million in 1902 to $28 billion in 1956, and rates of increase has gone up even more rapidly in the more recent years. For instance, from 1942 to 1953 local expenditures just about tripled and in the following four years increased another 33 per cent.

[10] Jervis J. Babb, **Guiding Metropolitan Growth,** Committee for Economic Development, p. 9.

[11] Dr. Luther Gulick, "Have We Outgrown Our Local Governments?," **The Little Economies,** Committee for Economic Development, p. 22.

[12] Robert C. Wood, **Metropolis Against Itself,** Committee for Economic Development, p. 13.

At face value, these statistics are appalling, but they are just as startling when allowances are made for conditions over which local governments have no particular control. From the 1930's, about one-third of the higher costs must be charged off to inflation and another 20 to 25 per cent to population growth. Also, just as people demand more and better quality of products they buy, they exert presures for more and better government services.

INCREASE IN SERVICES

"Thus, even the lower income component of the population arrives at a definition of acceptable welfare services which require a considerably higher level of expenditure than ever before. And suburbanites, as well as city dwellers, are prone to insist on steadily improving quality standards for the particular services they deem vital. They will only temporarily contend with water wells and septic tanks in place of sewer systems, and will be content to settle for amatuer government, volunteer fire departments and fewer police only for a short period of time. Typically, they expect the highest standards for their schools, a function which accounts for over half of the budget in most American localities, and their penchant for libraries, recreational services, and health facilities is growing."[13]

Even so, it would be futile to argue that this multiplicity of jurisdictions in our large cities is an economic and efficient way of handling local government. *A team of 20 mules is not as efficient as a single diesel engine.* Moreover, disregarding the many problems in our cities that cry for solution possibly only under a metropolitan concept, duplication or waste in local government takes money from people who would most likely spend it for items that would improve business and the entire private economy. By the same token these wastes in-

[13] Robert C. Wood, **Metropolis Against Itself,** Committee for Economic Development, p. 17.

crease taxes on industry and business, and increase the cost of doing business.

If the trend to *urbanism* is to continue, and there is not the slightest indication of reversal, it also follows that ". . . more people living more closely together require more regulations—in public safety, health and housing. Increased specialization in the private sector of the economy means that the governments must undertake the responsibility for providing water and handling sewage disposal which rural citizens assume for themselves. Technological advances require corresponding increases in public service: business requirements for skilled manpower place new importance on the public schools, automobiles need highways, and when modern medicine advances life expectancy, it concurrently expands welfare programs. All these conditions require more public investment, better public service, and more professional administration."[14] They also require an overall planned solution, with governmental machinery capable of making decisions for the metropolitan complex, rather than decisions for small uncoordinated parts of the city.

METROPOLITAN SOLUTIONS

What are the problems facing cities which must be solved on a metropolitan basis? A listing could almost be endless, but here are some of the most important:[15]

1. Traffic congestion, lack of parking, inadequate street patterns, collapse of mass transportation system and other related facets of the total metropolitan transportation system.
2. Inadequate water supply and problems of waste disposal and water pollution.
3. Un-economical patterns of land development, incompatible uses of land and inadequate zoning and other development controls.
4. Under-development of recreation and other essential leisure-time community facilities and services.
5. Inadequate school facilities.
6. Problems of hospitals, medical care, mental health, and other aspects of health.
7. Delinquency and crime control.
8. Race relations.
9. Housing needs.
10. Urban blight
11. Civil defense
12. Air pollution and noise abatement
13. The planning problem—inadequate long-range metropolitan and regional planning.
14. The governmental problem—the lack of regional and metropolitan policies and governmental devices to guide decisions and actions of local units of governments on metropolitan matters.
15. The problem of local finances—the growing disparity between financial resources and needs for municipal services and facilities.

All these and many more problems presently face American cities. The future must bring their solution if the American economy is to grow and expand, for it is the sum of these *little economies* that total to the national economy.

Transportation is one of the most pressing problems. People must have means of moving cheaply and quickly into, out of, and around the metropolitan city. Without a solution, it is entirely conceivable that our cities could strangle themselves economically. In such cities as New York, dependent on a collapsing commuter train system, strangulation is no idle threat. Smaller cities, too, are having trouble with mass transportation facilities—busses and trolleys—and even more trouble with moving cars and providing parking for workers.

NEED FOR WATER

Water supplies are no longer a problem in just the West. *The day the taps run dry* is a threat to cities in the East, the

[14] Robert C. Wood, **Metropolis Against Itself**, Committee for Economic Development, pp. 15-16.

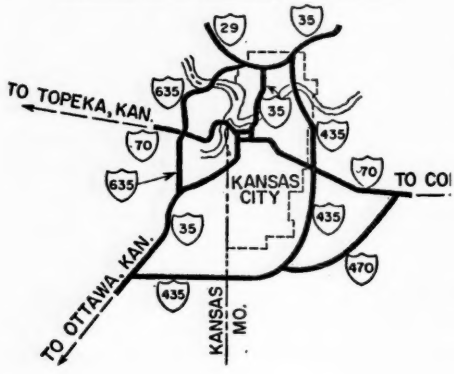
[15] Statement of F. Stuart Chapin, Jr., **Hearing before the Subcommittee on Reorganization and International Organizations of the Committee on Government Operations, United States Senate, Eighty-sixth Congress, First Session on S. 1431 and S. 2397**, pp. 9-10.

Mid-west and the West. Not only must cities find additional sources of water; the streams that have supplied them in the past must be cleaned up, and pollution ended so available water is palatable.

Here can be drawn an example of a metropolitan problem close to home. During the past year, in the Kansas City metropolitan area, several cities have voted bonds for sewer and disposal facilities to end pollution in the Missouri river caused by these municipalities. Each is planning its own facilities without or, at least, with only slight regard to plans of others. And not one has taken any strong leadership to examine whether combined efforts might be both more economical and efficient. These sewage disposal facilities are necessary, but they are not separate problems for each municipality in the area. Adequate handling of sewage disposal should be considered on a metropolitan basis, taking advantage of drainage areas. As it is, one municipality is pumping its sewage from part of a drainage basin in which another municipality is erecting facilities to handle its sewage in the same drainage basin.

Housing, both for habitation and for commercial and industrial use, goes hand in hand with blight and renewal as a problem.

INTERSTATE ROUTES IN METROPOLITAN KANSAS CITY
Missouri State Highway Department



"The value of tangible real estate in our cities is conservatively estimated at more than $500 billion. For this generation these capital facilities represent a life trust, to be used responsibly and to be conserved and supplemented. But this responsibility is not being adequately met. The spread of blight and obsolescence is visible in most of our urban areas.

"Estimates of the capital requirements to renew our cities cover a wide range—from $120 billion up. These estimates assume that three-fourths to seven-eights of the total outlay will take the form of private capital outlay. The government's role is viewed as setting the stage for private development and providing financial assistance only to the extent required to permit the private real estate market to function effectively."[16]

TAX INEQUITIES

Local government financing places some parts of large areas on a starvation scale while other sections have opulent budgets. It is almost impossible to justify that the labor force in a metropolitan city—all working in a single economic system—should have different qualities and amounts of public service and pay different tax bills because of residential location. Frequently, too, the size of the tax bill does not reflect the number and quality of services received.

Each of these problems requires more time and space than is possible here, but all resolve themselves to four basic factors that desperately need re-examination in the immediate future. We need to consider from the metropolitan aspect:[17]

[16] **Guiding Metropolitan Growth,** Committee for Economic Development, p. 7.

[17] Statement of Ben West, Mayor of Nashville, Tennessee, **Hearing before the Subcommittee on Reorganization and International Organizations of the Committee on Government Operations, United States Senate, Eighty-sixth Congress, First Session on S. 1431 and S. 2397,** p. 15.

1. Jurisdictional limitations or other inadequacies of existing governmental organizations,
2. Area-wide service and control deficiencies,
3. Financial inequities, inequalities, and weaknesses, and
4. Difficulties in or lack of popular control of governments in the area.

Even if the present system of government could be defended economically or philosophically, certain by-products of this system will sooner or later force consideration of change. A fixation of the service concept of government and an insistence, based on prejudice, petty jealousies, and hatreds, that "—political automony and multiplicity continue, can mean only that no vision of what the metropolitan city can be will prevail. As each governmental unit goes its own way, urban sprawl with spreading blight, cheap commercial development along highways, poor recreational facilities, inadequate schools, poor administration, smog, traffic problems and any number of other irritations of mis-directed growth will continue and grow to plague our cities.

"So long as the present system of government exists, the regional (metropolitan) economic system itself functions less effectively. Lacking a mechanism for regional policy-making, the metropolitan political system is unable to use planning, zoning, redevelopment, and transportation programs to assist the processes of production and distribution. Instead—since governments cannot take into account the new facts of regional economic life, they make these processes less efficient. Their mistakes in investment and regulatory programs, their competitive attitude toward their neighbors, mean extra costs for private business. Thus, when redevelopment authorities do not assign the appropriate economic uses, when the transportation system fails to provide easy access to work or bypasses sub-areas otherwise suitable for development, when water is not available at attractive industrial sites, the economy assumes additional burdens. Public investments and decisions made at the wrong time, in the wrong place, and in the wrong way serve . . . to counteract the trend or mainstream of development, and thus are completely ineffectual or act in such a way that the whole economic structure is rendered less efficient. At a time when rapidity of growth seems a critical factor in national survival, this tendency of government to work at cross purposes to the economic system way well be the most serious consequence of all."[18]

SUMMARY

Here then is the economic problem of large cities, and its solution must come in the future. A metropolitan community has only one purpose—to provide a place in which to live and earn a livelihood. Its existance in a particular place, at a particular time, its growth or decline, all are dependent on the expansion or contraction of opportunities for employment and investment.

But are the citizens of our large cities ready to act boldly to meet their problems? It seems they do not want to recognize what they know to be true—haphazard development, choking traffic, creeping blight and many other evident failures of the system. They still dream of wide open spaces, green pastures and still waters of a day long past. Nevertheless, the time has come that leaders must move forward —give recognition to the fact that America is now and in the future will be more of an urbanized land with its people, its work, and its culture concentrated in the large cities. They must devise a system of local government to meet these conditions. No longer can large cities afford the luxury of *fractionated local government.*

Not all our cities are going to advance

[18] Robert C. Wood, **Metropolis Against Itself,** Committee for Economic Development, pp. 42-43.

at the same rate—some may even decline—but those that look ahead, act imaginatively and provide an attitude of confidence and well-being to their businesses and to their people, need not fear the future.[19]

These will be the cities of the future. These "will be more efficient as a place in which to do business, to work, to shop and to hire workers; will develop fewer slums; will give the builder and developer greater security for his investments; will make it easier for people and goods to move about; and will meet the basic community needs for water, waste disposal, circulation, and public land uses on an orderly basis instead of on an emergency, makeshift and high cost basis later on."

[19] Dr. Luther Gulick, "Have We Outgrown Our Local Governments" **The Little Economies**, Committee for Economic Development, pp. 20-21.

Selecting An EDP System

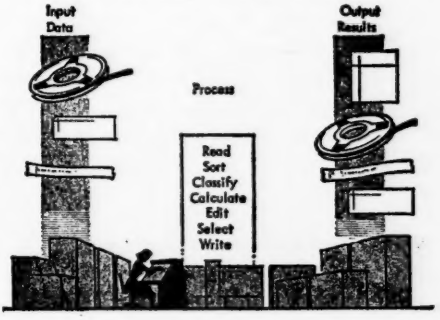
HENRY M. STEELE
Associate Professor of Statistics
University of Missouri

During the past few years nearly all government officials and business executives have been confronted with the impact of EDP (electronic data processing) on their areas of operation and responsibility. Whether this awareness of EDP has resulted from the necessity of fulfilling the duties of one's office or of maintaining one's competitive position, or from the never ending search to find better ways to perform and control operations, consideration of the potentials and resulting problems of converting to an EDP system has become a major project in the schedules of today's governmental and industrial leaders.

A common approach to evaluate the potentials of EDP within an organization is to assign several people to conduct a feasibility study. Such an endeavor, when adequately approached, becomes a major undertaking lasting from a few months to a year or more. The study group normally is best staffed by carefully selected personnel from within the organization, but major contributions are often made by representatives of the computer manufacturers. It is not uncommon to turn the task over to a group of outside consultants who are specialized in both EDP and the industry involved.

Volumes could be written on the art of conducting a sound EDP feasibility study,

AN ELECTRONIC DATA PROCESSING SYSTEM



but the purpose of this discussion is to touch on considerations subsequent to the study. The "computer committee" culminates its feasibility study with the presentation of its findings and recommendations to higher authority where the ultimate decision must be made.

Further discussion assumes that a decision has been rendered to select and install an EDP system. This decision may have resulted from the impulsive whim of an executive for the prestige of having a "giant brain," from the acknowledgment that one's competitors are doing it, or from a well executed feasibility study that indicates a computer installation to be economically justifiable and managerially sound.

Establishing the practicality of EDP is not predicated on a given computer system

of any one manufacturer. In fact, the feasibility study can be more rationally conducted if the group does not become embroiled in the many facets and the relative merits of the available computer systems. Once the decision has been made to adopt EDP, however, the next major decision, along with organizational problems, is the selection of a specific computer system.

Contact with the computer manufacturers may have been on a continuing basis during the feasibility stage, but certainly during the period of selecting a system the officials or executives with whom the decision rests will be besieged by waves of computer salesmen. Frequently two or three manufacturers will be "invited" to submit proposals. More may be obtained, but as the number of proposals received increases arithmetically, the confusion seems to increase geometrically. There currently are twelve companies in the United States manufacturing medium to large scale computer systems.[1]

EQUIPMENT CONSIDERATIONS

Companies soliciting the computer order will present generalized procedural approaches to the probable areas of application of the new EDP system. They will point out the educational, systems development, installation, and engineering services that they will render. But much too often they will engage in a multitude of minute characteristics as they extol the merits of their equipment over that of their rivals. As the pitch of the competitive struggle rises and charges and countercharges are made as to the relative advantages and specifications of available equipment, only the most informed and wary prospective buyer can avoid bewilderment during the ensuing "hardware battle." Seemingly encircled by a team of battle seasoned sales professionals, the computer prospect is barraged with such unfamiliar terms as magnetic core, microseconds, buffering, two address instructions, orthotronic count, index registers, word length, priority processing, binary coded decimal, and a host of other expressions.

Even in the advertisements and promotional literature available, one can hardly avoid being confused by the similar and conflicting claims. For example, in reference to cost:

extremely low cost per unit of work
the lowest cost per unit answer of any computer available
the lowest cost electronic computer on the market
assures the most efficient use of the data processing dollar
low cost per answer
processes more data per dollar in a working day than any other system
gives you *much more* for your data processing dollar

Or consider the references to engineering design:

the world's most advanced electronic data processing system
breakthrough: an entirely new concept in electronic computers
a significant breakthrough in computer design
represents a new achievement in computing machinery design
new design concepts
because of new, basic design techniques . . . the first in the industry to present a computer of this magnitude and power
a product of superior design

[1] The twelve companies are Bendix, Burroughs, Control Data, General Electric, International Business Machines, Minneapolis-Honeywell, National Cash Register, Philco, Radio Corporation of America, Ramo-Wooldridge, the Remington Rand Division of Sperry Rand, and Sylvania. At least six other companies produce small scale general-purpose digital computers and a number of firms manufacture analogue computers adaptable to production process control. Depending on speed and capacity, monthly rental ranges anywhere from $12,500 for one of the medium sized systems to $64,000 at the upper end of the larger systems. These are **average** monthly rentals and are, of course, higher for more than average capacity. Super computers are available at monthly rentals from $135,000 to over $300,000. Although infrequently done, computer systems may be purchased at anywhere from 40 to 50 times the monthly rental.

In each of these two sets of quotations, there are as many computer manufacturers represented as statements quoted!

On what basis, then, does one select an EDP system? In some cases, as in buying an automobile, the determining factor may be based on the lowest initial outlay of dollars, or it may be a like or dislike for one of the salesmen. But unlike selecting an automobile, external equipment design, as the aesthetic value of the tailfin height or front grill chrome, is not a factor in choosing an EDP system. Are hardware considerations, then, of any significance? Yes, certainly they are. Technological advances in equipment are continually being made, and just as one would not choose a Model T in preference to a Galaxie, except for its antique value, one would not select an older generation vacuum tube computer over the newer transistorized models. Computers representing the same stage of technology do not differ radically. Except in unusual applications where specific equipment specifications may prevail, hardware differences should be relegated to a less prominent role as other important factors are brought into proper perspective.

IMPORTANT FACTORS

An analogy is sometimes made between an EDP system and an iceberg, in that the hardware—the part you see—represents only a small fraction of what it takes to engender and maintain an effective system. Only about one-ninth of an iceberg is visible above the surface, and hardware characteristics often bear no more weight among the factors which determine the success, mediocrity, or failure of an EDP installation.

Internal to the organization adopting EDP are many factors, such as the extent of support from top management or administrative officials, the degree of cooperation from the organizational areas served, and the calibre of personnel selected to develop and operate the system, which affect the degree of success of the installation. In the selection of a specific EDP system and thus the supplier of the equipment, there also are a number of factors which should be investigated and considered. The relative importance of any one of these will vary as the conditions underlying any potential EDP installation will vary, but points worthy of consideration are:

- what personnel support will be provided
- which supplier has the greatest knowledge of the user's operation
- is the computer in actual use
- what programming aids are available
- what testing facilities are available
- what local service is available
- what stand-by equipment will be available
- how broad is the product line of the supplier
- what information exchange is there among users of the system
- will the supplier survive the competitive battle in the computer field

Personnel Support

The company selected to supply the equipment will assign anywhere from one to four or more of its representatives to work closely with the personnel of the organization procuring the EDP system. These technically oriented representatives are to provide training and guidance to assist the EDP user in achieving self sufficiency in the use and application of this new tool. Before placing an order for a computer system, the EDP prospect should satisfy himself that his organization will not serve as a training ground for the supplier's personnel.

It can not be expected that all of the representatives of the manufacturer will be seasoned EDP men and women, but at

least one of those assigned to the team should have previous EDP installation experience. One need no longer tolerate the blind leading the blind, but can benefit from the experience accumulated since the first EDP commercial installation was made nearly seven years ago. By all means, the prospective user should inquire into the number and calibre of those who will assist in the development and installation of the system.

Supplier's Knowledge

As the several computer manufacturers compete for the order, the prospect may evaluate which one seems to understand best the detailed operations of the organization. An awareness of the myriad of problems confronting the organization is essential if the supplier's representatives, serving somewhat in the capacity of outside consultants, are to participate effectively in proposing changes and in developing new systems approaches which will more efficiently utilize the potentials of EDP.

This knowledge of the internal operations and problems of the organization may ensue from previously having supplied office machines or other data processing equipment, or it may stem from an active participation in the feasibility study. The background and knowledge of the manufacturer's personnel, not only pertaining to the internal functioning of the organization but also with respect to the problems of the industry, are an indication of the quality of the support that will be received.

Computer Existence

Is the computer that is proposed in actual operation, or does it exist only on an engineer's drawing board? Is an order to be placed for a system that is tried and tested, or that is theoretically feasible but unproved by extensive field operation? The risk may be great in serving as an experimental guinea pig for the computer manufacturer. The costly experience is still fresh in the minds of the officials of a few firms and agencies that ordered a computer system that was untested and then on installation proved to be operationally defective.

The prospective buyer should never hesitate to request a demonstration of the proposed equipment. A reliable supplier is eager to demonstrate his products. Even for the most newly announced computer systems, before the original production models become available, a well tested prototype should be available for demonstration. The prospective EDP user should proceed cautiously when considering computers not yet in physical existence.

Programming Aids

The sequence of instructions by which a computer performs its various operations is known as a *program*. An instruction is composed of a set of digits, letters, special symbols, or a combination of these. In this machine language form the program may assume an intricacy far beyond the ability of computer programming personnel to utilize efficiently. Thus symbolic programming languages have been developed which permit an individual to code a program in a form more expedient to him. A special program, known as a *processor* and already expressed in proper machine language, interprets the symbolic language program and converts it into a machine language program which thereafter is in a form ready for immediate use.

During the past few years the ingenuousness of programming systems has advanced remarkably. For some systems it is now possible to write instructions in quasi-English. Although this has in no way lessened the systems analyst's complex task of defining the problem and of developing new approaches, the burden of coding instructions has been greatly alleviated.

The computer manufacturer also may provide extensive libraries of utility pro-

grams which may be adapted readily to the needs of the individual users. In some cases entire applications are already programmed and are available which will greatly reduce programming cost.

When a sales representative talks glowingly about advanced programming languages, establish if they are available *now*. A remarkable programming system that is supposed to be ready some time in the future, and thus is still untested, is no substitute for a comparable programming language already in use. Some organizations have found themselves preparing for the latest in EDP equipment with rather antiquated programming systems.

Establish what programming aids are currently available for the computer systems under consideration. This can significantly affect the time, and thus the cost, of developing computer programs.

Testing Facilities

During the 12 to 24 months which are normally required to prepare for the installation of a medium to large scale computer, the programs for the initial EDP applications are developed and tested so that operation may begin when the equipment arrives. Each manufacturer maintains testing facilities where free[2] time is provided for trial runs of the programs under development. The geographical proximity and availability of the testing facilities will affect pre-installation costs.

Another factor in testing, which is directly related to the existence of the computer, is the availability of a computer of the same model as the one to be installed. Some organizations have had to test their programs for a large scale system by simulation on smaller, intermediate sized systems. Although the simulation of one computer's operation on another is preferable to no testing at all, it tends to be inefficient and unavoidably has a number of restrictions. It can become highly undesirable when the simulation testing has to be performed on a smaller system with less capacity and void of many of the features available on the larger computer.

Local Service

Also worthy of consideration in selecting a manufacturer is the extent and quality of the services which are available locally. Nearly all computer firms will provide on site programming schools when an equipment order is obtained and during preinstallation activity. At other times, however, this training may be available only at some distant city. The extent of the supplier's local facilities also may govern the effectiveness of equipment maintenance, the availability of application and equipment specialists for consulting, the frequency and diversity of other training programs, and a host of minor services.

Equipment Stand-by

When an organization so concentrates its data processing functions in one computer system, it can ill afford to have that system inoperative for any but the shortest periods of time. Computers, like any other equipment, must have periodic maintenance to function properly. Many systems operate with an unusually high degree of reliability, with their "down time" for unscheduled maintenance being no more than one or two per cent of available processing time.

Some thought should be given to the contingency of an extended operational delay in the event of equipment malfunction. Various alternatives exist, depending on how extensively the model under consideration has been accepted and installed by other organizations. A common approach to this problem is to enter into a reciprocal agreement with another user of the com-

[2] The multitude of gratuitous services, such as education, literature, consulting, programming aids, test facilities, personnel assistance, etc., are included, of course, in the basic price of any computer system.

puter system. Data centers or computer centers are now being established in a number of cities by several of the manufacturers. These, if equipped with the proper system, or a test center, if not too distant, might also be employed in an emergency.

Product Line

The area of data processing has many facets. Some firms produce only one or two models of electronic computers, while others have many more or also engage in marketing equipment for such functions as data collection, data transmission, character sensing, optical scanning, and a number of other data processing operations.

Some computer systems contain auxiliary units which are produced by a rival manufacturer. In instances such as this, where equipment of more than one supplier is integrated into a single system, a dual responsibility exists on the maintenance of the equipment. Although this ordinarily creates no special problems, on a few occasions rather irksome situations have arisen where the maintenance personnel of each supplier has attributed the system malfunction to the other's components.

Along with evaluating the merit of the number of equipment manufacturers to engage, the EDP prospect should assess the extent to which the firms direct their resources into research in data processing and the fruitfulness of this research in terms of equipment improvements and announcements of new products.

Information Exchange

The users of a number of the computer systems have formed organizations through which they share the benefit of each other's experience and seek solutions to their mutual problems. In addition to the exchange of valuable information through the mail, at periodic meetings, through informal conversations as well as the formal sessions, they critically evaluate one another's ideas, apply themselves to specific areas of interest, and exchange generalized programs, routines, techniques, and systems approaches.

Existence of such a user organization and the opportunity to participate in it is another of the factors to weigh in evaluating an EDP system.

Supplier Survival

Technological changes are occurring rapidly in electronic data processing. It is reasonable to expect that within five years from installing a computer it may be advisable, and perhaps competitively necessary, to replace the system with one which then may be more advanced or economical. In selecting a computer manufacturer, one would do well to ponder the prospects of this manufacturer still being in the computer business five years hence.

The majority of firms now marketing medium and large scale computers entered the field within the past four years. Already one firm has withdrawn. Due to the nature of the industry—heavy investment, large development costs, and deferred revenue due to most systems being leased rather than purchased—all firms, with but two exceptions, are currently operating at a loss on their EDP business. Obviously the long run expectation is to recover all costs and show a profit, but during the interim some staggering losses are accumulating.

Fortune magazine not long ago predicted that perhaps no more than four firms would survive the competitive battle over the larger EDP systems:

> A slam-bang sales battle is developing among the builders of giant electronic computers. One of the results may be to place some of the most intricate and ingenious mechanisms ever conceived by the mind of man within reach of virtually every company in the U. S. Another result, perhaps more certain: the painful exit of some very substantial firms from the computer business.
>
> . . . . . .
>
> Because the computer business is so complex,

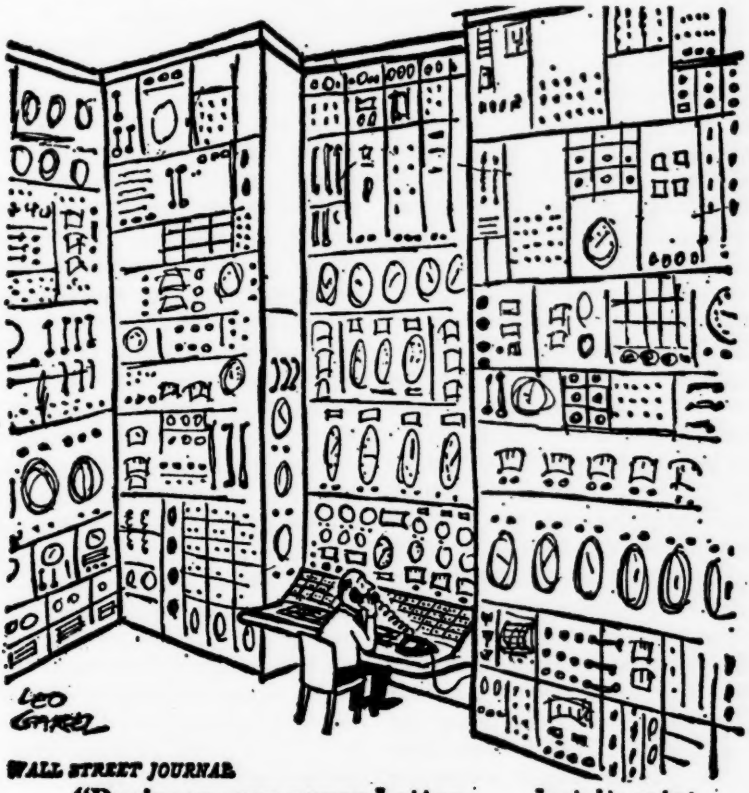
and the cost of developing the biggest machines is so high, it seems likely that only three or four firms will be able to hold the pace.[3]

SUMMARY

Equipment specifications can be important and must be evaluated. But the prospective user should not permit himself to be overwhelmed by equipment emphasis and thus lose proper perspective for many of the other important considerations. Other factors which may be vital to an orderly installation and a smoothly operated EDP system are the personnel support which will be received; the supplier's knowledge of the organization's operations; existence of the computer; the nature of programming aids, test facilities, and local services that will be available; the extent of the supplier's product line; information exchange among users; and the likelihood that the manufacturer will continue to produce and service electronic data processing systems.

After a careful appraisal of these many factors, the organization adopting EDP should be able to select a system with greater confidence that a sound decision has been reached and that their forthcoming efforts to install and operate an EDP system will bring them the many obtainable advantages of this new revolutionary tool.

[3] "The War of the Computers," **Fortune** LX (October, 1959), 128-129.



WALL STREET JOURNAL

"Business was never better . . . but it gets awfully lonesome at times."

Part One of a Two-Part Analysis
of Long-Range Planning for Highways

Long-Range Physical and Financial Planning for Highways

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Among planners, those formulating highway programs are, perhaps, most fortunate since most of them live to see at least a portion of their dreams become realities. In many other areas of public affairs the men who do the initial long-range planning, those who decide upon capital outlay programs and authorize their execution, those who control the expenditure of the funds required, and those who direct the agencies that put the plans into effect are not the same, nor are they in many instances even responsible to the same authority. In the area of the highway function, particularly in those segments under state administration, the responsibilities for planning, programming, fund allocation to projects, and execution (management) are customarily consolidated under a single authority.

This happy situation is no chance occurrence. It is the outgrowth of more than forty years of careful consideration by Federal and state legislatures and executives of the close relationship that exists between highways and the general welfare, and of the most efficient means of obtaining what the public requires and demands. The part played by public opinion in this situation must not be underestimated. Legislative bodies generally are reluctant to legislate very far in advance of crystallized public opinion; public opinion in favor of improved highways and highway administration has been vocal, indeed, over the past forty years, and, even more important from the standpoint of the legislative bodies, it has, largely without exception, indicated a willingness on the part of the citizenry at large to accept higher levels of taxation for the provision of better highways.

It is the purpose of this article to show how this fortunate situation facilitates the management of the highway function, and how this fact-finding—planning—operating alliance works in practice. To do this in a manner that will be clearly understandable, it is necessary first to consider the background against which the present modus operandi has developed; to outline the steps necessary to the achievement of a highway plant adequate not only for present but also for future demands; to describe the methods by which physical, or so-called "engineering," needs are deter-

mined and programmed; to describe the methods by which the parallel financing requirements and programs are established; and, finally, to consider, albeit superficially, some of the more important and difficult problems that must be faced and surmounted if a complete financing plan is to be produced. Related matters, such as highway classification and administration, will be touched upon wherever it is pertinent to do so.

BACKGROUND

Federal Statutory Authority

Section 307 of Title 23, United States Code—Highways, contains important provisions pertinent to highway research, and to physical and financial long-range planning for highways. It authorizes the Secretary of Commerce to engage in research on a broad range of subjects, including highway modernization, financing, traffic conditions, including the effect of state laws in these areas, and to publish the results of such research. In carrying out these authorizations the Secretary is empowered to conduct studies independently or in cooperation with any other branch of the Federal government, with state agencies or other institutions or agencies, profit or nonprofit, or with individuals. The law further provides that with the approval of the Secretary not to exceed 1½ per cent of the sum apportioned to any state for any year shall be available for expenditure, upon request of the state highway department, to be used with or without matching funds, for engineering and economic surveys, for the planning of future highway programs, and the financing thereof, for the regulation and taxation of highway use, and for other purposes.

This language is the outgrowth of a continually increasing recognition by the Congress of the Federal interest in and responsibility for research and planning in connection with the nation's highways, dating back insofar as existing provisions are concerned to 1921. The Federal interest in the determination of highway needs and in long-range highway planning is further expressed in other portions of the law, and in regulations prescribed by the Secretary of Commerce pursuant to paragraph 315 of Title 23 USC.

Federal-State Partnership

The history of the Federal-State partnership in the development, provision, and operation of an integrated nationwide network of highways is replete with examples of needs determination and long-range planning. However, although some notable work was done in individual states prior to that date, it was not until after enactment of the Hayden-Cartwright Act of 1934, which initially authorized the use of not to exceed 1½ per cent of the Federal-aid apportionments for research and planning, that planning became an intrinsic activity in all of the state highway departments. Although this provision of the law was permissive rather than mandatory, officials of the Bureau of Public Roads supported it so vigorously that within two years all the (then) 48 states and the District of Columbia had inaugurated study programs which came to be generally known as statewide highway planning surveys.

The initial phase of planning-survey activity consisted of a series of what were expected to be one-time, fact-finding studies, the principal objective of which was to gather together basic facts and present them in significant relationships for consideration by highway administrators engaged in the formulation of general administrative policy. It was expected that in the individual states comprehensive reports on these investigations would be prepared that would define the major highway problems facing the states, and suggest solutions, or at least approaches to solutions, to some of them. It was hoped that the infor-

mation provided would be sufficient to render intelligent policy decisions possible, but no recommendations were to be made on matters of policy.

By 1941 the basic studies had been completed, or nearly so, in almost all of the states, and one or more summary reports on these undertakings had also been prepared in a considerable number. It had already become evident, however, that if future highway programs were to be planned intelligently the one-time studies would not be enough. It was obvious that studies in various additional areas which had not been included in the original planning survey program were badly needed. Also, it was evident that there would be a continuing need to bring up to date most of the various types of basic information collected during the initial study.

The Bureau of Public Roads took note of this situation at an early date, and on September 28, 1938, issued to its field staff a memorandum outlining a basis for continuing state highway planning activities. Provision was made not only for updating the original studies, but also for collecting types of information not previously collected for which the need had become evident. The program outlined in this memorandum, with certain revisions and supplements, forms the basis upon which continuing fact-finding studies are now underway in all the present 50 states, the District of Columbia, and Puerto Rico.

It was not intended that this fact-finding activity should, of itself, extend into the area of general or long-range highway planning. It was recognized that responsibility and authority for this broader function belonged at the top level in the state highway departments, to the state legislatures, or to the combined branches of government; and it was assumed that this broader function would be exercised by or under the direction of some committee or other body representative of this authority.

Postwar Emphasis on Long-Range Planning

Many factors combined between 1940 and 1945 to emphasize the need for the long-range planning of highway facilities and services, but three which were in themselves interrelated served to force the issue. These were: the effects of World War II; passage of the Federal amending act of July 13, 1943; and passage of the Federal-aid Highway Act of 1944.

The impact of the war placed a tremendous burden upon the nation's physical highway plant which, subjected also to a moratorium on construction and progressively greater undermaintenance, began to deteriorate rapidly.

This situation was clearly recognized by the Congress when it passed the Act of July 13, 1943. Among other provisions, this act amended previous legislation to make additional authorization for the survey and planning of postwar highway construction projects,[1] and "authorized and directed" the Commissioner of Public Roads to "make a survey of the need for a system of express highways throughout the United States, . . . and the approximate cost of construction; and to report to the President and the Congress . . . the results . . . with such recommendations for legislation as is deemed advisable."[2]

This study was duly completed and the report, known as the "Interregional Highways" report,[3] formed the basis of much of the legislation incorporated into the 1944 Act. This Act, besides providing for a three-year postwar construction program, authorized Federal-aid for projects on the

[1] 57 Stat. 560, Section 3.
[2] Ibid., Section 5.
[3] "Interregional Highways: Message from the President of the United States Transmitting a Report of the National Interregional Highway Committee Outlining and Recommending a National System of Interregional Highways." House Document No. 379, 78th Congress, 2nd Session. U. S. Government Printing Office, Washington, D. C., 1944.

Federal-aid highway system in urban areas, provided for initial designation of the National System of Interstate Highways, and broadened the provisions for the use of Federal-aid funds in engineering and economic investigations and research.[4]

Separation of Fact-Finding and Planning

Within a very short period the states began to take the action necessary to begin large-scale, postwar highway planning. Many, but by no means all, of the special studies needed were undertaken under the direction of special committees created by the state legislatures. Studies of both the engineering (physical) and fiscal needs of the highways were usually involved; and integrated long-range plans in both areas were developed. In most instances, the studies were delegated to consultants engaged especially for the purpose, but in all cases the principal data sources utilized were those of the fact-finding divisions of the state highway departments.

There was no real conflict between the new long-range planning studies and the continuing fact-finding activities of the highway departments. In fact, the undertaking of long-range studies by groups outside the state highway departments was exactly in line with the philosophy expressed in the Public Roads memorandum of September 28, 1938. It was generally believed that programs prepared under outside sponsorship, with legislatures, other governmental agencies, highway users, and other interest groups being represented on the study committee along with state highway department officials, and with the studies being made by qualified but "disinterested" outside parties, would be given more wide-spread acceptance and support, especially if other than state highways were included, than would be the case if the reports were prepared under highway department auspices.

[4] "Federal-aid Highway Act of 1944." 58 Stat. 838.

Evaluation of State Highway Needs

A canvass of the states concerning the status of long-range highway needs and finance studies reported to the Highway Research Board in December 1947[5] indicated the following situation:

Earlier studies completed—6 States and District of Columbia
Studies in progress, or just completed—9 States
Studies authorized by legislatures—8 States
Studies authorized by administrative directive—13 States
No action contemplated—12 States

Some of the earlier studies referred to had been completed before World War II and were already out of date. Several of these, as well as some of those then in progress, were inadequate in not covering all road systems or all desirable subject areas (such as financing or administration).

Since the Kennedy paper of 1947 nearly all of the 48 contiguous states and the District of Columbia have had at least one formal long-range highway needs study, and several have had more than one. Because of differences in the nature and content of some of the studies, and the absence of published reports in certain instances, it is impossible to be precise in classifying certain states according to type or extent of studies made. A 1955 compilation by the Committee on Highway Costs of the Highway Research Board divided publications resulting from highway needs studies into two groupings; "basic-need studies" and "related material."[6] Thirty-three states were shown as

[5] "Current Long-Range Studies of Highway Modernization Programs," by G. Donald Kennedy. In **Highway Finance,** Bulletin No. 12, Highway Research Board, Washington, D. C., 1948. Pp. 57-64.

[6] **"Selected Publications of State-Highway-Need Studies,"** Committee Report 3, Committee on Highway Costs, Department of Economics, Finance and Administration. Circular 287, Highway Research Correlation Service, Highway Research Board, Washington, D. C. August 1955 (Processed.)

having published "basic" reports between 1945 and 1955, and six additional states were indicated as having published "related material."

A paper prepared for the 37th Annual Meeting of the Highway Research Board included a "selected bibliography of highway study reports published since 1945."[7] It included several reports not found in the 1955 list, but added only one state to those having reported on needs-study activity. Of the nine jurisdictions not listed in either publication, studies were known to have been completed in two prior to 1945; a study was completed but the report withheld in one; while studies were recently completed and some reports published in two. This leaves four states in which the status of formal needs evaluation and long-range planning were in question. However, all of the 48 contiguous states and the District of Columbia have made at least two recent estimates of the construction needs of all roads and streets within their boundaries; one in 1954 for the study required by Section 13 of the Federal-aid Highway Act of 1954,[8] and another in 1957 pursuant to the stipulation contained in Section 210 of the Highway Revenue Act of 1956.[9]

"Outside" Participation in Planning

In a footnote to the September 28, 1938, memorandum of the Bureau of Public Roads, the assumption was made that, for obvious reasons, the function of long-range highway planning would be exercised by or under the direction of some board, committee, or other authority outside the fact-finding division of the state highway department. The extent to which this philosophy has been adopted cannot be checked readily, since technical responsibility for many of the published reports relating to long-range needs determination and planning is simply ascribed to the state highway department. However, in such instances it is often known that although the highway department is listed as being technically responsible for the report, professional or technical assistance from outside the department was called upon in one way or another in connection with its preparation. The same is known to be true for a number of reports ascribed to "legislative committees," "highway planning committees," "highway advisory boards," and similar agencies.

Many of the long-range needs and planning reports have, however, been prepared by and are ascribed to agencies or individuals outside the state highway departments, and the present trend seems to be toward a larger percentage of these reports being prepared in this fashion. A check of 36 reports prepared by "outside" agencies or individuals since 1945 indicates that 13 were made by or with the technical assistance of a single private nonprofit organization, the Automotive Safety Foundation, of Washington, D.C. Of the 23 remaining, four were prepared by quasi-public agencies, seven by universities (or bureaus subordinate to them), seven by private consulting firms, and five by individuals acting as consultants.

Of the 36 reports, 18 were of the strictly "engineering needs" type and did not include financing proposals. All of the 13 studies made by or with the assistance of the ASF fell in this category; three were made by consulting firms, and one each by a quasi-public agency and a university. Fourteen of the 36 reports covered long-range finance and tax studies, only, with or without accompanying engineering needs study, of which one was made by a quasi-public agency, six by

[7] "What Should Highway Needs Study Reports Contain?" By Homer A. Humphrey and James A. Foster. In **Highway Needs Studies**, 1958, Bulletin 194, Highway Research Board, Washington, D. C., 1958. Pp. 8-10.
[8] 68 Stat. 70.
[9] 70 Stat. 374.

universities, two by private consulting firms, and five by individual consultants. The remaining four of the 36 reports were combined physical needs and financing studies, two of which were prepared by quasi-public agencies and two by consulting firms.

It may be noted that the ASF is dominant among "outside" agencies making engineering needs studies, while universities and individuals dominate the fiscal-study field. This is a most logical development. When long-range highway planning activity by the states began in earnest about 1945 top-level officials of the ASF, a non-profit organization sponsored largely by the automotive industry, saw the need for making available to the states, at cost, a staff of technical people proficient in highway planning who could provide the specialized services needed for such a study. They proceeded at once to assemble such a staff, largely made up of men with state highway department experience, and offered their services to the states. The response was enthusiastic, the quality of the work produced was good, and the reputation and stature of the staff grew apace.

A circumstance which favored this development was that the engineering needs studies (including studies of highway classification and administration) lend themselves to "packaging"—that is, the same general procedures and measures can be adapted to almost any state. This, because of circumstances peculiar to the situation, is not true in the case of the fiscal and tax studies. Here, the peculiarities of individual states render each a separate and distinct case, not readily amendable to "package" treatment. However, in this area the universities, especially their departments or bureaus of government or business administration, are in an especially favorable position to possess the professional capabilities and familiarity with governmental finance, particularly in their "home" states, to cause them to be especially well-fitted for such services, and several states have availed themselves of them. On the other hand, certain qualified individuals (usually economists or engineer-economists), who had prior background in similar work, undertook to make one such study and thereby gained experience and proficiency which made them especially valuable to other states for undertaking similar studies.

BUILDING AN ADEQUATE HIGHWAY NETWORK

It has often been said that transportation is the life blood of a nation, and that the various transportation media provide the circulatory system through which this blood stream flows. If this analogy be true, and it is seldom contested, we can go one step further and conclude that the health of the body political will be just as severely affected as would be that of the body physical by any malformation or malfunction within its circulatory system. Since questions relating to matters of balance or proper integration among transportation media are beyond the scope of this article, we must assume that it is public demand which measures the need for highways and highway services, and that when this demand is adequately met the requirements in these respects will have been properly fulfilled.

Phases of Long-Range Studies

Boiled down to their simplest terms, there are four fundamental questions that a statewide long-range highway planning study must set out to answer:

1. What are the social and economic factors which cause and will continue to cause a demand for the improvement of highway transportation facilities and services, and how may these factors be measured?
2. What classes and types of highways, and how many miles of each class or type are needed to supply present and expected future needs, and what will it cost to own them?

3. Can the people of this state afford to own such a network of highways, and how shall an adequate long-range highway program be financed?
4. How can an adequate network of highways be administered most effectively?

Consideration of these questions suggests a convenient division of long-range-planning activity into four principal phases: economic and sociological, engineering or physical, financial, and administrative.

The economic and sociological phase will deal primarily with factors that influence the demand for highway services, such as population composition, distribution, and trends; wealth, income, and the characteristics—including trends—of agricultural, industrial, and commercial development; and past, present, and future characteristics of motor vehicle ownership and use.

The engineering phase will be concerned mainly with such matters as highway classification, general location, design standards, measurement of present and future needs—both physical and fiscal—and determination of construction and maintenance requirements.

The financial phase will involve study and the development of one or more solutions to the vexing problems of how to finance this network of highways adequately and equitably, and how to fit the highway fiscal program into the general scheme of support for all governmental functions at all levels.

The administrative phase is primarily concerned with the development of one or more plans for administering the highway network most efficiently and effectively.

The scope of each phase may be broadened or narrowed according to the requirements of a given state, the specifications of the legislative or other directive under which the work is carried on, or the authority or interests of the group directing the study. Thus, the administrative phase may upon occasion be so broad as to include (but not be limited to) definite plans or general recommendations on:

1. Matters of basic highway policy.
2. Major reclassifications of highways for administrative purposes.
3. Reorganization of state, county, and/or local highway departments.
4. Definition of duties and recommendation of salary ranges for various groups of highway department employees.
5. Appraisal of existing highway laws, with recommendations for codification, revision or new legislation.

Scope of Highway Needs Studies

General Administrative Memorandum No. 319 issued by the (then) Public Roads Administration on September 24, 1947, contains an outline for a complete report or series of reports on a comprehensive statewide survey for the determination of highway needs, and the establishment of future improvement and financing programs.[10] This outline was intended to serve as a guide rather than a directive to the states in making such studies. However, an analysis of 50 or more highway needs study reports presented to the Highway Research Board by Humphrey and Foster in 1958 indicates that the reports on comprehensive studies (i.e., those covering both the engineering and financial aspects) have generally followed the Public Roads outline rather closely,[11] although several reports rather than a single one have usually been prepared following such all-inclusive studies.

The 13 divisions in the Public Roads outline appear to cover, by implication at least, all of the necessary areas of study except that of highway law which in some

[10] This outline is included as an appendix to and discussed in a technical paper, "Information Needed for the Fiscal and Allied Phases of Long-Range Highway Program Planning," by C. A. Steele, in Bulletin No. 12, **Highway Finance**, issued by the Highway Research Board in August 1948, (pp. 42-46).

[11] "What Should Highway Needs Study Reports Contain?" by Homer A. Humphrey and James A. Foster, in **Highway Needs Studies 1958**, Bulletin 194, Highway Research Board, 1958, pp. 1-10.

states merits careful attention. It is possible that the administrative section of the study could be broadened to include this phase, but where the constitutional and legislative provisions for the highway function are sadly in need of revision, a special phase providing for a separate intensive study of highway law should be included in the highway needs project organization.

Organizing the Long-Range Highway Needs Study

In most of the comprehensive long-range highway planning studies that have thus far been made the physical or engineering needs portion of the project has been conducted by one staff, the financial study by a second, and the laws study (when made) by another. The administrative study may or may not have been set up separately also. Each staff has customarily prepared a formal report for publication supplemented by a file of working papers which provide the detail that could not be included in the formal report. These reports are customarily addressed to the authority at whose direction the work was done. This authority may elect to transmit them directly to the official or body to which its responsibility extends, it may prepare its own report based upon those submitted to it, or it may choose to do both. The third alternative is probably the course of action most frequently adopted, in which case the report by the authority usually takes the form of a summary of the formal staff reports, possibly including recommendations of its own which may or may not agree with those made in the staff reports. In a few instances the sponsoring authority has chosen to disregard or even suppress some or all of the staff reports.

Problems of Coordination

Where two or more groups work on different phases of a needs study, especially where each submits its own independent report, both activities and reports are bound to cover the same areas to some extent. Consequently, unless the forecasts of the basic factors which will determine future highway needs are developed jointly, or are at least accepted by both those responsible for the physical needs study on the one hand and those responsible for the fiscal needs study on the other, there can be no real integration of the physical and financial programs. Similarly, unless there is agreement between the recommendations arising from the highway classification study and those arising from the administrative study neither can have much weight.

All of this means that significant problems of partitioning work, scheduling activities, marshaling resources, enlisting cooperation, delegating authority, and integrating findings face those who are given the responsibility, by legislative fiat or otherwise, of undertaking comprehensive highway needs studies. Unfortunately, the situation is frequently complicated by the necessity of completing the entire operation within a limited period which does not allow sufficient time for completing each of the activities which must be undertaken in proper sequence. For example, although a considerable amount of work on certain phases of the fiscal study can be undertaken before the physical needs study and resulting program are completed, other time-consuming phases of the fiscal study, such as the preparation of one or more financing plans, cannot be started until the proposed improvement program (or programs) is developed.

Public Hearings

The legislative committee or other authority sponsoring the statewide long-range highway needs study will ordinarily schedule several public hearings on the project as it progresses. Such hearings, usually held at the state capitol and a number of other places throughout the state, are a very im-

portant and valuable adjunct to the operation. They provide opportunities for the citizenry to become informed about the study, and to offer opinions on the nature of the road problems in their areas.

The timing of these public hearings is extremely important. As F. B. Farrell has pointed out,[12] there has been a tendency to hold some of these hearings even before field work has begun, when there is little in the nature of concrete proposals or even procedures to present. In Farrell's opinion, "public hearings can be of tremendous value in stimulating local cooperation when they are held at the time the counties, cities, and towns are contacted with respect to making an engineering appraisal of their own particular road and street needs. Since a high degree of public interest is desirable at the time of issuance of the report, public hearings are also of value when held just in advance of the date of issuance. Possibly the best arrangement is for some hearings to be held at both times."[13]

Data Sources and Analysis

Without the vast resources of data that have been accumulated over the years by the highway planning groups within the state highway departments it would be utterly impossible to undertake and complete needs studies within any reasonable period. Where these fact-gathering activities have been carried on according to the continuing program suggested by Public Roads, at least the following information should be available on a reasonably up-to-date basis:

- Total highway mileage, rural and urban, by road system and surface type.
- Amount and composition of traffic using the various road and street systems.
- Characteristics of motor vehicle ownership and use (e.g., density of ownership, frequency of trips of various trip lengths, purposes of travel, distribution of travel by time of day and season of the year).
- Actuarial data on investment, service lives, depreciated value, etc., of highways on primary system.
- Historical statistical series on motor vehicle registrations, fuel consumption, and total motor vehicle travel.
- Historical statistical series on the receipts, disbursements, intergovernmental transfers, and debt transactions of all levels of government for highway and related purposes (such as sidewalks and street lighting).
- Various types of economic data indicating the need for highway services, values gained from such services, etc.
- Information pertaining to the administration of the highway function (e.g., state highway department organization charts and other data; county and local highway organization data; and compilations of highway laws).

Even this vast store of information will not be adequate for purposes of a comprehensive highway needs study and must be up-dated and supplemented with a vast amount of additional information. Whoever makes the physical and fiscal needs studies will find it necessary to depend largely upon the highway department fact-finding staff not only for information such as that detailed above but also for the collection, analysis, and interpretation of much of the additional information such as detailed estimates of physical needs that it will be necessary to obtain and process.

However, the data-gathering activity will also require the whole-hearted support and cooperation of officials of other government agencies, both highway and nonhighway, at all levels of government. Thus, county and city highway engineers will be required to contribute toward the development of adequate design standards for the various classes of highways under their supervision and toward the estimation of both the capital and maintenance requirements of these

[12] "Conducting Long-Range Highway Needs Studies," by F. B. Farrell. In **Public Roads**, Vol. 25, No. 6, December 1948, pp. 121-128. U. S. Government Printing Office, Washington, D. C.
[13] Ibid. p. 122.

highways. Also, state and local tax and fiscal authorities will be called upon to contribute knowledge and statistics relating to these vital areas of governmental concern.

The sheer magnitude of the task involved in a comprehensive long-range highway planning study renders it imperative that the full resources of the fact-finding, data-processing, and other units in the state highway department be available to those making the study. The availability of sufficient qualified professional personnel is, of course, a prime essential, but the need for adequate staffs of technicians and clerks is also imperative. Within the limitations ordinarily applying, it is neither feasible nor desirable for consultants or others engaged in studies of this type to develop separate staffs to accomplish all phases of the data collection and analysis involved, although the final interpretations and recommendations stemming from such analysis must, perforce, be their responsibility.

Coordination of Long-Range Plans

The construction of a major highway facility has an important and lasting impact on all the areas through which it passes. Therefore, such facilities should not be planned and constructed without due consideration being given not only to the existing character of the neighborhoods and communities affected, but also to the long-range regional and community plans that have been or are being developed for these areas.

Highway officials have sometimes been criticized for going ahead with the construction of highway facilities without regard to the wishes or plans of local officials and residents of the areas affected. Occasionally such criticism is justified, but in the majority of cases the highway officials were forced to take the action they did by circumstances beyond their control. For example, in many areas long-range plans for land use and general development have not yet been crystallized; in some cases geographic features, such as rivers or mountains, dictate where highways must be located if they are to be built at all; while in others local planning authorities in the individual communities are in such a state of disagreement among themselves, and with overlying planning and development agencies, that highway officials could not look to them for guidance.

It must be remembered that highway officials work under legislative and administrative directives which sometimes leave them little room for discretionary action as to where a given route shall be located, how it shall be designed, or whether it shall go into or bypass communities of certain sizes. Thus, to meet these legal requirements for Federal-aid, it is necessary that certain classes of routes must form a "connected" and "integrated" system of highways, interstate as well as intrastate, and that they must meet certain minimum standards in right-of-way width and design features. Similar or even more restrictive language is often found in state laws concerning highways.

It has sometimes been proposed that important highway construction, especially in urban and suburban areas, be deferred until area-wide long-range plans and zoning regulations have been completed and enacted. Unfortunately, the spiraling transportation needs of our burgeoning population centers cannot wait overlong for such time-consuming activities to take place for, as was stated previously, transportation is the life blood of modern society, and to let the arteries through which it flows become clogged to the point where the national or local well-being is thereby debilitated is intolerable. Consequently, in the face of the bickering and vacillation that sometimes accompany attempts to establish effective area-wide planning, especially where several jurisdictions are involved, highway officials have had to push ahead with major highway improvement programs, using their

best judgment aided by the efforts of local officials and their own planning staffs, to determine what should be done.

Putting Plans into Effect

An old adage says that "the proof of the pudding is in the eating." The proof of long-range highway planning is found in the highways that eventually are built to serve the public need. But long-range plans cannot be translated into completed highways merely by the waving of a magic wand. To do the job completely will usually require many actions such as modification of basic enabling and controlling laws; regrouping of highways for administrative purposes; completion of extensive preconstruction activities, including location and traffic surveys, intensive economic studies, plans preparation, and right-of-way acquisition; setting up cooperative arrangements among governmental jurisdictions and agencies as required for the program; providing adequate financial arrangements, including credit financing and/or adjustment of taxes used for highway purposes; constructing the facilities; and making proper provision for maintenance and eventual reconstruction.

Obviously, this is an extremely complex and usually time-consuming process. Fortunately, for those who benefit directly or indirectly from the provision of adequate highway facilities—and that includes everybody to some degree—the ability to plan, organize, and effectuate the necessary actions is probably more highly concentrated in the field of the highway function than in any other area of government activity. Even so, there is frequently considerable delay in achieving even a partial realization of the recommendations arising from long-range highway planning studies. Legislatures often balk at enacting the necessary legislation, enact only a portion of it, or enact legislation having a different effect than that sought. Highway administrators sometimes fail to take the recommended steps in highway classification and departmental reorganization that are within their power. And occasionally the public fails to do its part by approving necessary bond issues and other required financial measures.

There probably never will be an instance where all the recommendations stemming from a comprehensive highway needs study are accepted and placed in effect immediately. There have even been certain disappointing situations where these recommendations either produced such a storm of controversy or fell on such deaf ears that it appeared that no tangible results were attained. In most cases, however, some of the needs-study recommendations and proposals are so obviously worthwhile that they are adopted at once, while others are adopted more slowly—perhaps in modified form—and only a few are rejected entirely. Experience has indicated, however, that even when needs-study proposals have apparently been rejected or forgotten they have still made an impression, and frequently these rejected or forgotten recommendations become the basis for other proposals that are adopted at a later date.

Part Two of Mr. Steele's analysis of Long-Range Physical and Financial Planning for Highways will appear in the May-June issue of the Review. It will include a review of how physical road needs are determined, the legal and management aspects of a long-range highway plan, and the problems of financing expanded highway programs.

Summary of Recent Missouri Highway Research Reports*

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HIGHWAY FACTS IN MISSOURI

The Automotive Safety Foundation's report, *Highway Facts in Missouri,* is a survey of the state's rural and urban road needs, including primary and supplementary state highways, local rural roads, state highway extensions, arterial, business, and residential streets.

After a year and five months of research, the Foundation concluded that:

> **During the next 20 years nearly every existing mile of road or street in Missouri will wear out or become obsolete, requiring major improvements or extraordinary maintenance. To make these replacements and to maintain and operate the systems will require expenditures of about $7.3 billion during the next 20 years.**

In its study the ASF used road standards developed by the Missouri State Highway Department. The department set three classifications of road conditions.

Design standards are the "criteria to which a road section should build or be reconstructed." Tolerable standards mean that a road "can carry traffic at lower operating speeds with less safety and efficiency." Those roads failing to meet even the second category are classed as "intolerable." The ASF's application of these standards to Missouri roads can be seen in the table.

The report presents three different catch-up periods to meet highway needs: for 10, 15 and 20 years and finds that "though annual amounts vary considerably, total costs for 20 years differ but little." A shorter period is more desirable because postponing needed improvements will result in higher over-all costs. "As traffic volumes continue to increase, hazardous conditions inherent in earlier construction will become greater."

The Foundation finds that "traffic operation on Missouri's streets and highways is hampered by a lack of uniformity, by the use of unnecessary controls and a general lack of coordination between state and local agencies. Widespread use of improper traffic signs, signals and markings is inimical to the safe and efficient use of city streets and rural highways.

"The General Assembly should move to bring driving rules in closer conformity with the recommended Uniform Motor Vehicle Code. It should establish a Model Traffic Ordinance and permit cities to adopt such ordinance by reference. All units of government should be required to ad-

*The studies were financed by the Missouri State Highway Department and the U. S. Bureau of Public Roads. Final reports are available from the Highway Department in Jefferson City.

PRESENT AND FUTURE ROADS

Missouri Mileage	Condition Now	Future
State Highways		
		By 1973
29,800 rural	10,860 intolerable	
447 interstate	116 fully developed	658 scheduled to be built
Rural		
		In 20 Years
7,369 primary	39% deficient	Another 57% will be deficient
22,048 supplementary	36% need immediate improvement	The other 64% will need resurfacing or reconstruction
In Cities		
St. Louis & Kansas City	143 freeways needed	
Other Cities		
1,316		95% will need improvement
Urban Streets		
11,940	25% resid. unpaved	
Local Roads		
67,266	47% intolerable	
	13% modern construction	

here to a manual on uniform traffic control devices prepared by the State Highway Commission."

During 1959, highway travel in Missouri totaled nearly 17.5 billion vehicle miles, including out of state motorists. The report points out that "more than one-half of all passenger car trips, whether done by rural or urban dwellers, are made in connection with earning a living. This, perhaps more than anything else, points up the importance of highways to the healthful functioning of Missouri's economy."

The report emphasizes the importance of an "ultimate freeway system," that will "connect all cities over 10,000 population and all but eight cities between 5,000 and 10,000." In rural areas this system would total 2,531 miles, and in urban areas 328 miles.

In Missouri 31 per cent of the rural roads are a state responsibility. "A major reduction of state responsibility to include only roads of state-wide importance (as is the case in most states) would be desirable. However, it is recognized that the step would not be practicable immediately in view of the present lack of adequate local highway organizations to assume greater responsibility."

The ASF criticizes the division of responsibility in the administration of local rural roads, where 976 separate authorities are responsible for construction and maintenance. It recommends that administration be consolidated in the county government, and that the supervisor be a professionally qualified engineer. The State Highway Department would be "assigned the responsibility for co-ordinating county road matters, for reviewing and approving plans and programs and preparing general reports to the General Assembly on county road progress."

FINANCING MISSOURI'S ROAD NEEDS

The report of the University's Bureau of Business and Economic Research, *Financing Missouri's Road Needs,* is primarily a financial study.

The Bureau did not pass judgment on

the $7.3 billion figure recommended by the Automotive Safety Foundation. Most of the research centered upon the questions of tax revenue and apportionment, although a study of local road administration was also made.

The report stresses the importance of the road system to the entire economy. "Roads provide access to homes and farms, facilitate the administration of government, are vital to national defense and furnish useful services in connection with industrial, commercial, educational, religious, recreational and community services." The value of farmland nearly always rises in proportion to the quality of the nearby roads.

The Bureau divided taxpayers into two groups. "Users" are those who own motor vehicles and actually do the traveling—individual drivers, passengers, trucking firms, etc. These are presently taxed through the fuel tax and registration fees. The rest of the public—the "non-users"—are taxed (but not, at present, for roads) through the sales, property and state income taxes.

Having determined that all sections of the public should pay for roads, the report then considers three alternative methods of cost allocation before adopting the Earnings-Credit Solution. Under this method through traffic on interstate and other primary roads (e.g., urban freeways) is assigned entirely to users. On secondary roads (state roads which are not federal highways) the cost is divided among users and non-users. On local and rural roads most of the cost is assigned to non-users.

If this method were used, Missouri highway users would pay 59.6 per cent of the costs of road construction and maintenance, leaving 40.4 per cent for non-users. Of the projected $7.3 billion, approximately $4.4 billion would come from user taxation and $2.9 billion from non-user.

Contributors to the report emphasized that the Earnings-Credit Solution was not a perfect solution, but the best that could be devised with the available information. Factors not considered are: the extent to which user taxes are included in trucking fees, the increase of non-resident travel (estimated at between 13 and 17 per cent for the period 1955-58), the extra cost of construction and maintenance for heavy trucks, and the "piggy-back" system of transporting trailers by rail.

The report considers the three ASF "catch-up" plans and concludes: "When both rural and municipal state highway needs are considered together, it becomes impossible, at current state user tax rates, to finance any of the ASF plans on a pay-as-you-go basis. It appears that it will be necessary to raise user rates and, perhaps, to sell bonds during the early years of any ASF program that may be adopted."

The Bureau found that if the state government does spend $7.3 billion on roads over the next 20 years, present taxes will only cover $4,880 million and a $2,420 million deficit will be incurred. Alternative tax and fee increases are suggested, including a 6 cent fuel tax, a 3 cent sales tax, a 75 cent increase in the property tax, a doubled state income tax, and a $7 increase in passenger car registration fees. These increases were found to total $5.8 billion additional. Varied combinations of the above proposals would cover the $2,420 million total deficiency. The Earnings-Credit Solution would require $910 million from users and $1,510 million from non-users to meet the deficit.

The report found that "even with the astounding post-war increase in spending, Missouri still ranks below many other states in terms of per capita expenditures for education and highways, although quite high in welfare."

In the section on city streets, the report finds that "it appears unlikely that the cities would be able to raise such large sums (for any of the ASF catch-up plans),

relying on their own resources." If any major improvement program is to be undertaken on city arterial and residential streets, a large part of the necessary revenue must come from sources other than local taxes.

The needs of local road administrations are also reviewed. There are 976 separate authorities in Missouri responsible for the construction and maintenance of roads, and the report found that there is little regularization of administration and procedures among them. It suggested that these local units should not receive State aid unless they improve and standardize their operating procedures.